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ENGINEERING AND EXPEDITIONARY WARFARE CENTER

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BIOFUEL PILOT AT ST. JULIENS CREEK AND PROPOSED NAVFAC POLICY ON USE OF BIOFUEL IN HEATING BOILERS

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Naval Facilities Engineering and Expeditionary Warfare Center (NAVFAC EXWC) was tasked by NAVFAC HQ with facilitating a pilot study on the use of B20 Biodiesel (20 % biofuel mixed with 80 % fossil fuel oil hereafter referred to as B20) heating fuel at St. Juliens Creek Annex, NNSY VA, Central Heating Plant.

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EXECUTIVE SUMMARY

Naval Facilities Engineering and Expeditionary Warfare Center (NAVFAC EXWC) was tasked by NAVFAC HQ with facilitating a pilot study on the use of B20 Biodiesel (20 % biofuel mixed with 80 % fossil fuel oil hereafter referred to as B20) heating fuel at St. Juliens Creek Annex, NNSY VA, Central Heating Plant. B20 was used in one "D"-type water-tube boiler with a capacity of 40,000 lbs of steam per hour. The pilot study's duration was from 08 September 2012 to 08 April 2013, burning 284,582 gallons of B20 while saving $32,148 in fuel cost. No notable maintenance and/or operational difficulties where encountered during the study period and fuel analyses after the study period, as late as the writing of this report, have shown no degradation or separation of the remaining B20 fuel while in storage. Due to environment (renewable) attributes of B20 as compared to conventional fossil fuel oil, and the ease of boiler and fuel system conversion to the biodiesel fuel without costly retrofitting, it is recommended that B20 be used where cost effective. In addressing needed changes in applicable criteria, Appendix A includes a proposed BMS mandating the use of B20 where practicable and economically feasible.

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ACRONYMS AND ABBREVIATIONS

ASTM	American Society for Testing and Materials
BDI	Biodiesel
BMS	Business Management System
DLA	Defense Logistics Agency
DLA-E	Defense Logistics Agency Energy
DoD	Department of Defense
FEC PW6	Field Engineering Command Public Works Utilities
FOR	Fuel Oil Residual
FY	Fiscal Year
FSX	Fuel Oil of Various types
FSD	Fuel Oil Distillate
NAVFAC ESC	Naval Facilities Engineering Service Center
NAVFAC EXWC	Naval Facilities Engineering and Expeditionary Warfare Center
NAVFAC	Naval Facilities Middle Atlantic
NNSY	Norfolk Naval Shipyard
NOx	Nitrogen Oxides
PM10	Particulate Matter between 2.5-10 microns (coarse)
PM2.5	Particulate Matter under 2.5 microns (fine)
ppm	Parts per million
SOx	Sulfur Oxides
STJ	St.Julien's Creek Annex
ULSD	Ultra Low Sulfur Diesel
USN	United States Navy
VA DEQ	Virginia Department of Environmental Quality

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1.0 INTRODUCTION

1.1 DOD and Navy Policy Promoting Expanded Use of Renewables

Current energy policy issued by the Secretary of the Navy is to increase alternative energy use DON-wide; "by 2020, 50% of total DON energy consumption will come from alternative sources". Although current fuel pricing favors the use of natural gas for heating, NAVFAC continues to have numerous activities where natural gas is not readily available and fossil fuel oil is the primary fuel, see Appendix B. At these activities, there is an option to switch to a renewable biodiesel alternative. Navy shore distillate fossil fuel oil use (not including transportation) is roughly 43,200,000 gallons per year (6,000,000 MMBtu/year). A complete conversion of all oil burning equipment to B20 would equate to a renewable use of 1,200,000 MMBtu/year (equivalent to 8,651,766 gallons of pure biofuel). A reduction in the use of fossil fuel oil is beneficial to national energy security and will help in complying with projected greenhouse gas regulations. The homegrown biofuel component of B20 will contribute to reduction in the Navy's dependence on foreign oil.

B20, a mixture of 20 percent biofuel and 80 percent petroleum, is typically the highest percentage of biofuel that is considered a "drop in" replacement that can be burned without costly boiler and fuel system modifications. B20 typically burns cleaner resulting in reduced boiler burner and fuel system maintenance.

On-base air quality will be improved by the increased use of biofuels. Biofuels exhibit lower emissions of sulfur dioxide, and particulate matter. Virgin vegetable oils, used as the biofuel component in the Saint Juliens Creek demonstration project, have lower sulfur content (~30 ppm) as compared to the sulfur content of typical petroleum fuel (500 ppm), thus sulfur dioxide emissions will be lower with biodiesel fuels derived from them. Significant reductions in Nitrogen Oxides (NOx) emissions (typically 20% lower bound nitrogen in the biofuel component) are seen with B20 fuel. Boiler stack emissions will also contain less soot (PM10 and PM2.5). See the Department of Energy's September 2006 Report DOE/GO-102006-2358, "Biodiesel Handling and Use Guidelines."

1.2 Saint Juliens Creek Biofuel Pilot Purpose and Test Configuration

The test boiler for the Navy demonstration is located at St. Juliens Creek, near Norfolk Naval Shipyard in Portsmouth. It is a "D"-type water-tube boiler with a capacity of 40,000 lbs steam per hour, which is approximately 8% less than what is considered NAVFAC's median-capacity. The steps to convert this median-capacity boiler to burn B20 are:

- Verify/validate biodiesel fuel supply availability and develop contract for providing ample supply for pilot tests.
- Insure proper environmental boiler permitting
- Clean boiler fuel system and fuel storage tank(s)

- For both the start and the conclusion of testing, have the biodiesel boiler prepared for internal, and operational inspection and testing on the scheduled dates of the NAVFAC ESC/EXWC team visit.
- Boiler inspections reports, operating log sheets, and historical routine maintenance and repair records shall be kept and made readily available for review

1.3 Personnel Contacted

- Andy Gallagher, Thermal Commodity Technical Support Team Leader, NAVFAC MIDLANT, 1625 PIERSEY ST, Floor 3, Norfolk, VA, 23511, (757) 341-1161, andrew.gallagher@navy.mil
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2.0 TECHNICAL PERSPECTIVE

2.1 Biofuel

Biofuel is a biodegradable and generally cleaner burning replacement fuel made from natural, renewable sources such as new and used vegetable oils and animal fats. These oils and fats are chemically reacted with an alcohol, usually methanol, to produce biofuel fatty methyl esters. Driving forces behind increasing biofuel production include low commodity prices for feedstocks used to produce biofuel, environmental concerns with continued petroleum use, and national security concerns about increased usage of foreign crude oil. Foreign crude oil currently accounts for nearly 40 percent of the petroleum used in the U.S.

Emissions from the combustion of pure biofuel (B100) are essentially free of sulfur and aromatics and have less hydrocarbons, carbon monoxide, and particular matter. B100 has a higher cetane number and about five percent lower energy delivery. A B20 biodiesel mixture will exhibit improved air emissions and have a heating value comparable to petroleum based heating oil.

2.2 Biofuel Use in Heating Boiler

Biofuel use for heating is mandated by numerous states and municipalities in the Northeastern part of the United States. These mandates require the use of fuel oil containing between 2% biofuel (B2) and 5% biofuel (B5). Currently all major equipment manufacturers will warranty heating equipment up to a B5 biofuel mix. Utilizing B20 across the DON will contribute greatly to meeting renewable goals. B20 is a common commercially available blend of biofuel; it is the fuel with the greatest percentage of biofuel still considered a "drop in" replacement not requiring modifications to boiler and fuel handling hardware. If a boiler still under the manufacturer's warranty is a candidate for switching to B20, contacting the manufacture to see if burning B20 will affect the warranty is recommended. Concerns are:

- Air permit must allow for the burning of B20.
- Biofuel tends to clean out piping with previous deposits collecting at the burner nozzle. To mitigate this problem the tank and fuel lines must be cleaned before conversion to biofuel.
- Boiler combustion controls need to be carefully retuned adjusting fuel to air ratios.
- Some biofuel mixtures have a relatively short shelf life. They may separate or have problems with extreme temperatures, and/or exposure to air or sunlight. Care should be taken to mitigate these issues by monitoring fuel condition and properly planning for fuel storage, and usage of a biofuel mixture with a shelf life of six to twelve months.

2.3 Economic Evaluation and Process of Conversion to Biofuel

The main economic factors to consider when evaluating conversion to B20 are:

- A favorable price differential between B20 and standard petroleum fuel equivalent on a consistent Btu content basis

- The one-time cost of modifying the air permit to allow for burning of B20 (costs range $2500 - $25,000 per installation in FY13 dollars). The permit should allow for switching between standard petroleum fuel and B20.

- Cleaning the fuel tank and fuel lines is necessary since the biofuel has solvent properties that can dissolve the accumulated sediments in the fuel storage tank(s) when the biofuel is first introduced. These sediments may clog fuel lines. Cost of cleaning range from $2500 to $50,000 in FY13 dollars, depending on the size of the tank. This is an additional cost only if the work is performed outside of the required, already budgeted, 5-year API 653 internal tank inspection cycle since tanks are cleaned before inspection.
- The cost to retune the boiler combustion controls. This will include adjusting the fuel/air mixture, and size and shape of burner flame (burner nozzle may need to be replaced) to be efficient and environmentally acceptable at all rates of fire. The cost is $125 to $2500 in FY13 dollars, per boiler depending on size and complexity. This is an additional cost only if the work is performed outside the required periodic boiler tune-up.

3.0 PILOT TEST EVALUATION RESULTS AND ANALYSIS

3.1 Pilot Test Boiler

The biofuel pilot test was conducted using one “D”-type water-tube boiler with a capacity of 40,000 lbs steam per hour. The location was at the central heating plant, at St. Juliens Creek Annex Portsmouth VA, see Figure 1-1. The manufacturer warranty was of no concern since this boiler is out of the warranty period.

Figure 1-1, “D”-Type Water-Tube Boiler at St. Juliens Creek

3.2 Pilot Test Period, Fuel Consumption and Cost

The pilot test was performed from 8 September 2012 to 8 April 2013, burning 284,582 gallons of B20, while saving $32,148 in fuel cost. Please see Table 3-1 below.

Table 3-1, Pilot Fuel Consumption and Comparative Fuel Pricing

FUEL OIL PURCHASES AND COST FOR STJ								
FUEL TYPE - BDI								
Date	**Gallons**	**$ / Gal**	**$ to Govt**	**$ to NAVFAC**	**Delta to DLA**	**Delta to USN**	**DLA Standard $ / Gal BDI**	**DLA Standard $/ Gal ULSD #2**
8-Sep-12	14,907	$3.4103	$50,837.64	$33,093.54	$17,744.10	($1,341.63)	$2.22	$2.31
15-Sep-12	22,381	$3.4511	$77,240.05	$49,685.82	$27,554.23	($2,014.29)	$2.22	$2.31
1-Oct-12	7,474	$3.6446	$ 27,240	$ 26,906	$333.64	($971.62)	$3.60	$3.73
8-Oct-12	7,479	$3.6353	$ 27,189	$ 26,924	$264.31	($972.27)	$3.60	$3.73
15-Oct-12	7,486	$3.5737	$ 26,753	$ 26,950	($196.58)	($973.18)	$3.60	$3.73
22-Oct-12	3,494	$3.4417	$ 12,025	$ 12,578	($552.96)	($454.22)	$3.60	$3.73
29-Oct-12	4,013	$3.4611	$ 13,890	$ 14,447	($557.25)	($521.69)	$3.60	$3.73
5-Nov-12	7,517	$3.4653	$ 26,049	$ 27,061	($1,012.24)	($977.21)	$3.60	$3.73
12-Nov-12	7,504	$3.3690	$ 25,281	$ 27,014	($1,733.12)	($975.52)	$3.60	$3.73
19-Nov-12	7,517	$3.4736	$ 26,111	$ 27,061	($949.85)	($977.21)	$3.60	$3.73
26-Nov-12	7,510	$3.4243	$ 25,717	$ 27,036	($1,319.21)	($976.30)	$3.60	$3.73
3-Dec-12	15,014	$3.4337	$ 51,553	$ 54,050	($2,497.13)	($1,951.82)	$3.60	$3.73
10-Dec-12	7,524	$3.3468	$ 25,182	$ 27,086	($1,904.78)	($978.12)	$3.60	$3.73
17-Dec-12	15,042	$3.3417	$ 50,545	$ 54,151	($3,606.51)	($1,955.46)	$3.60	$3.73
24-Dec-12	7,523	$3.4126	$ 25,673	$ 27,083	($1,410.11)	($977.99)	$3.60	$3.73
31-Dec-12	15,078	$3.3339	$ 50,861	$ 54,281	($3,419.80)	($1,960.14)	$3.60	$3.73
7-Jan-13	15,052	$3.4786	$ 52,424	$ 54,187	($1,762.90)	($1,956.76)	$3.60	$3.73
14-Jan-13	7,533	$3.4598	$ 26,063	$ 27,119	($1,055.83)	($979.29)	$3.60	$3.73
21-Jan-13	7,541	$3.5083	$ 26,456	$ 27,148	($691.36)	($980.33)	$3.60	$3.73
28-Jan-13	-980	$3.5442	$ (3,474)	$ -	$54.74	$127.44	$3.60	$3.73
4-Feb-13	7,545	$3.5944	$ 27,120	$ 27,162	($42.25)	($980.85)	$3.60	$3.73
11-Feb-13	15,070	$3.6226	$ 54,240	$ 54,252	($11.59)	($1,959.10)	$3.60	$3.73
18-Feb-13	15,086	$3.5769	$ 53,357	$ 54,310	($952.87)	($1,961.18)	$3.60	$3.73
25-Feb-13	7,532	$3.4135	$ 25,711	$ 27,115	($1,404.57)	($979.16)	$3.60	$3.73
4-Mar-13	7,538	$3.3707	$ 25,408	$ 27,137	($1,728.31)	($979.94)	$3.60	$3.73
11-Mar-13	15,073	$3.3719	$ 50,439	$ 54,263	($3,823.59)	($1,959.49)	$3.60	$3.73
18-Mar-13	7,529	$3.3297	$ 25,069	$ 27,104	($2,035.44)	($978.77)	$3.60	$3.73
25-Mar-13	15,080	$3.3433	$ 50,255	$ 54,288	($4,033.32)	($1,960.40)	$3.60	$3.73
1-Apr-13	0	$3.3291	$ -	$ -	$0.00	$0.00	$3.60	$3.73
8-Apr-13	7,520	$3.2872	$ 24,720	$ 27,072	($2,352.26)	($977.60)	$3.60	$3.73
Totals	284,582	$3.4483	$979,933.79	$976,565.76	$6,897.22	($35,504.10)		
FY13	247,294	$3.4496	$ 851,856	$ 893,786	($38,401.12)	($32,148.18)		
				DLA markup	($0.1553)			
Stock Fund Cost								
BDI	$3.60							

3.3 Pilot Boiler Condition Assessment

No notable maintenance and/or operational difficulties were encountered. Monthly fuel analyses as late as the writing of this report, have shown no degradation or separation of the remaining B20 in storage. See the closeout boiler inspection assessment in Appendix C.

3.4 Fuel Quality

All B20 fuel was purchased from the Virginia Based refinery PAPCO LLC, who sources from Allied Renewable Energy LLC and Virginia Biodiesel, using soy oil feedstock.

The pilot test did not reveal any adverse issues while burning the B20. During the test, there was no need to put additives into the B20. The ASTM standard for B20 is D6751, see Appendix D DLA-E Clause for Biofuels.

3.5 Future Heating Plant Locations for Biofuel Conversion

Since the findings are favorable, we have addressed needed changes in applicable criteria and have identified additional promising locations for possible conversion to biofuel. Appendix A includes a proposed BMS mandating the burning of B20 biodiesel (20% biofuel) where practicable and economically feasible. Prospects for immediate further conversion to B20 should be examined by each FEC PW6 and the respective activity as spelled out in the proposed BMS b-5.2.28 “Biofuel Use in Heating Boilers.”

4.0 CONCLUSIONS

The pilot has shown conversion to B20 fuel oil: is cost effective when appropriately planned; demonstrates no notable difficulties with conversion and subsequent maintenance and operation; has a more environmentally friendly and cleaner burning combustion (flame); and has a FY13 savings of $32,148.18 in lower fuel costs. Other less tangible benefits include increased use of renewables, decreased reliance on foreign oil and enhanced community ties built by purchasing a fuel source that is locally manufactured.

Path forward, approval of BMS B-5.2.28, currently a draft, will set NAVFAC Policy and will help speed the conversion of oil-fired heating boilers and usage of B20 biodiesel where it has favorable fuel prices over conventional petroleum fuel and where conversion expenses are not prohibitive. Past and future support from ASN on expanded use of Biofuels will aid the process.

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REFERENCES

There are no sources in the current document.

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APPENDIX A

PROPOSED BMS B-5.2.28 BIOFUEL USE IN HEATING BOILERS

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A.1 Soon to be posted on NAVFAC portal for Proposed BMS b-5.2.28 "Biofuel Use in Heating Boilers"

APPENDIX B

ACTIVITY FUEL USE BY FEC

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B.1 Fuel Oil Use NAVFAC MidLant By Fuel Oil Purchased

UIC	INSTALLATION_NAME	Fuel Type	Mbtu	COST	Qty gal
62688	NAVSTA NORFOLK VA	FSX	177,016	2,007,767	1,367,045.59
67001	CG MCB CAMP LEJEUNE NC	FSX	147,244	3,224,406	1,137,124.68
32411	NAVSTA NEWPORT RI	FSX	106,884	1,637,859	825,435.56
62688	NAVSTA NORFOLK VA	FOR	80,667	631,508	622,968.92
00146	MCAS CHERRY PT NC	FSX	73,926	1,487,721	570,910.05
00129	SUBASE NEW LONDON CT	FSX	52,104	932,530	402,384.78
00264	CG MCCDC QUANTICO VA	FSR	51,472	1,666,945	397,504.02
57095	NSA NORFOLK VA	FSX	50,484	647,209	389,873.97
32414	NSA MECHANICSBURG PA	FSX	37,858	656,830	292,366.86
32443	NSS NORFOLK NAVAL SHIPYARD VA	FSX	31,582	697,370	243,899.05
00183	NAVMEDCEN PORTSMOUTH VA	FSX	24,320	517,241	187,816.63
65923	FRC EAST CHERRY POINT NC	FSX	18,623	252,693	143,820.28
69212	WPNSTA YORKTOWN VA	FSX	5,994	119,195	46,290.00
68351	NOSC NE NEWPORT RI	FSX	1,399	6,175	10,804.09
50092	JEB LITTLE CREEK-FORT STORY VA	FSX	172	3,798	1,328.31
32446	NSY BOS PORTSMOUTH NH	FSD	78	1,683	602.37

B.2 Fuel Oil Use NAVFAC Wash By Fuel Oil Purchased

UIC	INSTALLATION_NAME	Fuel Type	MBtu/year	COST	Qty gal
61152	NSA ANNAPOLIS MD	FSX	61,746	1,297,604	476,847.28
00173	NRL WASHINGTON DC	FSX	48,961	850,953	378,112.26
47608	NAS PATUXENT RIVER MD	FSX	41,612	834,345	321,357.96
00264	CG MCCDC QUANTICO VA	FSD	39,212	643,524	302,823.43
68469	NSA WASHINGTON DC	FSX	33,034	742,280	255,112.44
61151	NSA SOUTH POTOMAC DAHLGREN VA	FSX	20,718	540,000	159,999.38

B-3 Fuel Oil Use NAVFAC South East by Fuel Oil Purchased

UIC	INSTALLATION_NAME	Fuel Type	MBtu/year	COST	Qty gal
60514	NAVSTA GUANTANAMO BAY CU	FSX	1,330,696	32,923,979	10,276,597.06
00213	NAS KEY WEST FL	FSX	201,027	3,410,146	1,552,475.91
42237	SUBASE KINGS BAY GA	FSX	45,202	936,759	349,082.54
00263	MARCORCRUITDEP PARRIS ISLAND SC	FSX	10,080	130,643	77,845.05
60201	NAVSTA MAYPORT FL	FSX	3,166	85,570	24,450.14
00207	NAS JACKSONVILLE FL	FSD	432	4,985	3,336.22

B-4 Fuel Oil Use NAVFAC Far East, HI and MAR By Fuel Oil Purchased

UIC	INSTALLATION_NAME	Fuel Type	MBtu/year	Cost	Qty gal
61078	NSF DIEGO GARCIA	FSX	562,987	14,209,424	4,347,792.85
61057	NAF ATSUGI JA	FSX	422,027	9,240,358	3,259,197.76
62613	MCAS IWAKUNI JA	FSX	406,459	9,319,593	3,138,970.41
61054	CFA YOKOSUKA JA	FSX	352,200	7,572,039	2,719,943.16
61058	CFA SASEBO JA	FSX	251,767	5,583,926	1,944,326.89
67400	CG MCB CAMP BUTLER JA	FSX	172,327	4,074,866	1,330,833.75
68470	NAVHOSP OKINAWA JA	FSX	14,289	285,431	110,349.99
32778	CFA CHINHAE	FSX	7,380	131,843	56,993.70
32778	CFA CHINHAE	FSX	7,380	131,843	56,993.70
61064	PMRF BARKING SANDS HI	FSX	29,233	718,662	225,758.37
00318	MCB HAWAII KANEOHE BA	FSX	6,069	148,891	46,869.21
61755	NAVBASE GUAM	FSX	20,624	417,929	159,273.45
68096	NAVHOSP GU	FSX	16,610	352,926	128,274.43

B-5 Fuel Oil Use NAVFAC EURAFSWA By Fuel Oil Purchased

UIC	INSTALLATION_NAME	Fuel Type	MBtu/year	COST	Qty gal
3379A	CAMP LEMONNIER DJBOUTI	FSD	534,628	15,254,205	4,128,784.13
62863	NAVSTA ROTA SP	FSX	98,716	1,668,061	762,356.36
62995	NAS SIGONELLA IT	FSX	44,350	1,090,550	342,502.78
62588	NSA NAPLES IT	FSX	8,730	108,234	67,419.37
66691	NSA SOUDA BAY GR	FSX	7,657	155,236	59,132.89

B-6 Fuel Oil Use NAVFAC South West By Fuel Oil Purchased

UIC	INSTALLATION_NAME	Fuel Type	MBtu/year	COST	Qty gal
00246	NAVBASE CORONADO SAN DIEGO CA	FSX	75,857	1,734,263	585,822.62
69232	NAVBASE VENTURA CTY PT MUGU CA	FSX	62,501	1,658,605	482,677.93
67399	CG MCAGCC TWENTYNINE PALMS CA	FSX	13,365	240,900	103,214.20
67865	MCAS MIRAMAR	FSX	1,429	30,133	11,035.77
66001	SPAWARSYSCEN SAN DIEGO CA	FSX	648	12,305	5,004.32
35949	NAVHOSP TWENTYNINE PALMS CA	FSX	279	5,051	2,154.64

B-7 Fuel Oil Use NAVFAC Mid West By Fuel Oil Purchased

UIC	INSTALLATION_NAME	Fuel Type	MBtu/year	COST	Qty gal
61018	NSA CRANE IN	FSX	3,478	-	26,859.63
00128	NAVSTA GREAT LAKES IL	FSX	1,557	24,027	12,024.28

APPENDIX C

EVALUATION OF ST JULIENS CREEK BOILER AFTER PILOT TEST FIRING WITH BIO FUEL ALTERNATIVE

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May 9, 2013

MEMORANDUM
From: Ray West, NAVFAC Engineering Service Center PW54
To: Steven Guzinski Division Director NAVFAC EXWC PW51

Subject: Evaluation of St Juliens Creek boiler after pilot test firing with Bio Fuel alternative.

Ref:////////
Encl: Preliminary pilot boiler fireside waterside evaluation report

Per Ref /////enclosure 1 is forwarded for your information and appropriate action.

Ray West
NAVFAC EXWC
Boiler Inspector

Evaluation of St Juliens Creek boiler after pilot test firing with Bio fuel alternative.

1. Per ref///// Preliminary pilot boiler fireside waterside evaluation report

2. NAVFAC EXWC, Provided an evaluation of the Bio Fuel Pilot Project test boiler located at St. Juliens Creek VA. The evaluation was conducted in conjunction with the NAVFAC MIDLANT PW regularly scheduled routine boiler inspection. NAVFAC EXWC Boiler Inspector Ray West on 6 May 2013. A NAVFAC MIDLANT Boiler Inspector was present during this regularly scheduled boiler inspection.

3. The findings and recommendations are made independently of any findings or recommendations proposed by other investigating individuals or agencies. All findings and recommendations contained in this report will be provided to NAVFAC EXWC and NAVFAC MIDLANT.

4. Our procedure is to analyze the physical conditions of the test boiler pertaining to the use of Bio-Fuel during the test period. Any recommendations concerning the conditions found during the evaluation are based on the condition of the boiler immediately after use of the test fuel.

5. This report contains an assessment of the condition of the fireside and watersides of the test after the test period using an 80/20 mixed Bio Fuel.

6. Personnel Present at time of investigation

   Andrew Gallagher NAVFAC MIDLANT Thermal Commodity Technical Support Team Leader

   Kurt Crist NAVFAC MIDLANT Thermal Commodity Manager

7. Boiler Operations:

   The boiler operates to provide building services throughout the site and is operated at a reasonably steady rate throughout the required seasonal usage period. Firing rate requirements steadily decrease as seasonal temperatures increase and building service requirements diminish. This particular boiler typically requires a minor retune to fire at a more efficient rate as heating service requirements decrease. This is not unusual in larger boilers of this type designed to sustain winter heating conditions as the ambient temperatures begin to increase.

8. Boiler condition at time of investigation:

   The boiler was open on May 6 2013 for its routine internal inspection allowing access to the firebox and water drum for the evaluation. The external examination of the casing revealed the outer casing is in very good conditions, no indications of hot spots or warping of casing panels are present, indicating externally that no localized overheating occurred during the test period.

   The firebox was examined for indications of improper combustion, areas of overheating, and indications of damage to tubes or refractory. The tubes have a light to moderate residue of soot that is consistent with the use of petroleum-based products for combustion. There is light flame impingement occurring that is common with many oil-

fired boilers operating at the low load firing rate experienced as the heating season demand slows. Adjustment of the boiler burner tune was completed to reduce this impingement and improve combustion as boiler demand decreases. Exposed visible refractory is in good condition, no indications of failure or excessive cracks are present. Refractory expansion joints are intact and show no indications of not functioning during boiler operations. Boiler tubes show no signs of overheating or deformations related to localized or wide area overheating.

The boiler burner assembly was evaluated in place. The burner nozzle and tube appear to be in good condition, there is no indication of fuel residue or soot on the end of the sprayer plate or on the diffuser. The burner throat and refractory areas are intact with no visible damage or unusual conditions.

The boiler's watersides are treated with a polymer based treatment system and are in good condition. There were no signs of overheating in the tube ends or tube sheet. Tube ends appear to be of equal length protruding into each drum tube sheet indicating that there are no tubes have indicated excessive heat levels. The tube sheets of each drum show no signs of warping.

9. Preliminary conclusions:

The minor soot buildup and minor low load flame impingement in the boiler firebox are consistent with firing of normal fossil fuels. There are no indications externally in the firebox or internally in the drums of any adverse overheating while using the test fuel. The boiler is in good condition and shows no signs of adverse affects from the Bio Fuel test operation.

Boiler Burner Front

Furnace Access Door at rear of Boiler

Exposed Bottom of Water Drum and underside Furnace Floor Plates

Furnace Access Door

Front Wall of Furnace

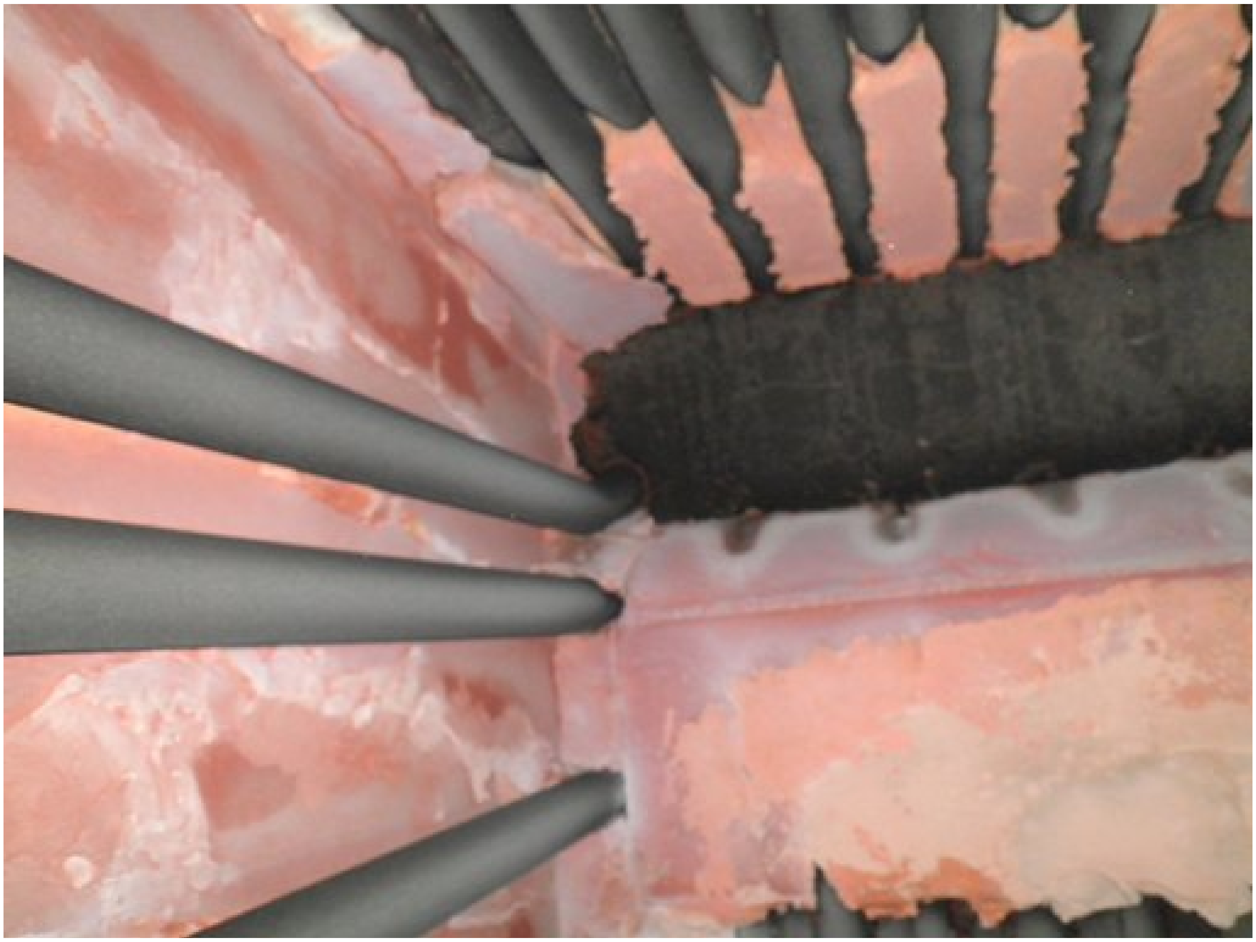
Full Length Furnace View

Furnace Rear Access Door

Water Tube Bends at rear of Furnace to Upper Drum

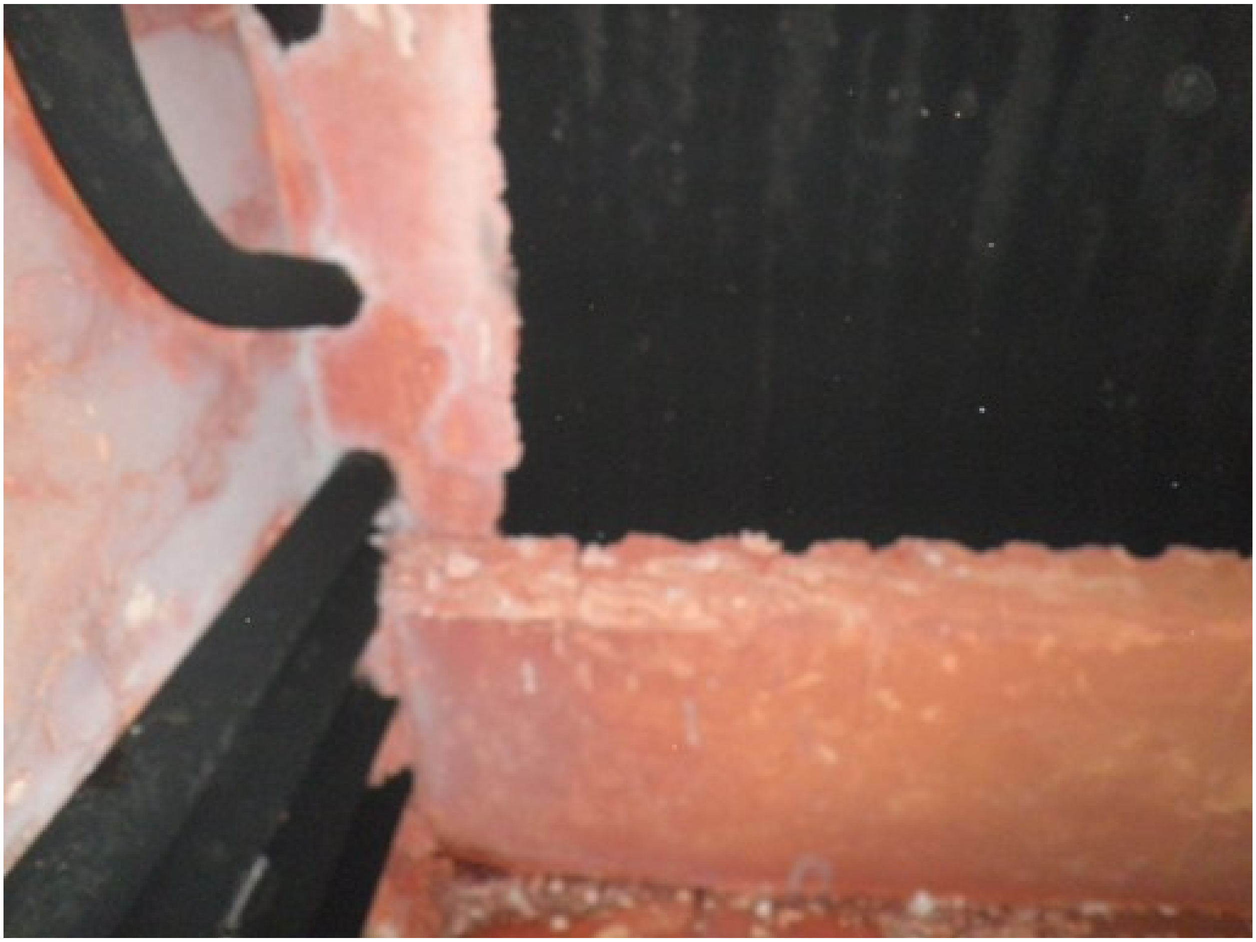
Water Tubes at Furnace Floor level above Lower Drum

Visible Bottom Portion of Upper Drum and Castable Copings



Front Wall Water Tubes Castable coping and Visible portion of Upper Drum

Front Wall Burner Assembly and Front Wall Water Tubes of Furnace


Lower Coping Front Wall and Side Wall Tubes above Lower Drum

Castable And Brick Burner Cone

Burner Diffuser and Burner Sprayer Plate

Burner Sprayer Plate

Right Side Wall Water Tubes toward Rear of Furnace

Left Side Wall Water Tubes toward Rear of Furnace

Lower Drum Tube Sheet and Exposed Tube Bells

APPENDIX D

DLA-E CLAUSE FOR BIOFUELS

C16.27 FUEL, BIODIESEL (B20) (DLA ENERGY JUN 2009)

In the event that a Federal, State, or local environmental requirement is more stringent than a specification contained in this contract, the Contractor shall deliver product that complies with the more stringent requirement. Supplies delivered under this contract shall conform to all Federal, State, and local environmental requirements applicable to the geographic location of the receiving activity on the date of delivery. Offered product shall conform to the following requirements that define a fuel suitable for use in automotive diesel engines:

(a) **PRODUCT COMPOSITIONAL AND PERFORMANCE REQUIREMENTS.** The finished fuel shall conform to ASTM D7467, with a biodiesel blend percentage of 20 +/- 1 percent, with the exception that the biodiesel component, per ASTM D6751, shall be derived solely from either virgin or used vegetable oils. Biodiesel derived from animal fats or tallows shall not be used. Product classification is shown below:

DLA ENERGY	MAXIMUM	
PRODUCT	SULFUR	
NATIONAL STOCK NUMBER	PRODUCT NOMENCLATURE	CODE
CONTENT	RED DYE	
9140-01-470-4520	Grade Number B20 S15	BDI
15 µg/g (ppm)	No	

(b) **BLENDING**. Product shall be blended prior to delivery. Manifold blending at time of delivery and blending in the receipt tank is not permitted. The resultant blended product must meet all performance requirements specified in the contract.

(c) **LOW TEMPERATURE OPERABILITY.** For fuel supplied during the months of October through March, the low temperature performance of B20 biodiesel shall be defined by the following property:

CLOUD POINT. Unless a more restrictive cloud point limit is specified in the contract schedule, the cloud point shall be equal to or lower than the tenth percentile minimum ambient temperature specified in Appendix X3 of ASTM D 7467.

(d) **ENVIRONMENTAL PROTECTION AGENCY (EPA) REGISTRATION.** B100 product must be EPA registered in accordance with 40 CFR Part 79, Registration of Fuels and Fuel Additives. The Contractor shall provide a copy of the EPA registration letter to the Contracting Officer at the time of offer.